Though retained in elementary expositions, serious science has abandoned it for ever.

The image B (1870 to 1890) left entirely on one side the conception of a special electrical substance, and sought to explain electrical phenomena by the properties of the æther alone. But although this picture enabled one to form a representation of radiant electrical energy, it, too, has been found insufficient to explain a great number of phenomena.

The image C is based on the notion of *electrons*, and forms, to some extent, a combination of A and B. It supposes the existence of a special substratum, and preserves the idea of modifications produced in the body of the æther; but the electrical substance is now considered as the origin of these modifications in the æther.

We have summarised these distinctions because they characterise the entire fascicule. Prof. Chwolson adheres to these distinctions throughout, and the result is that he is able to produce a final picture which is more free from confusion than if he had attempted to remove the dividing lines between them. Again, the student will leave his perusal of these pages with a far wider conception of the general lie of the land than if one or other of these points of view had been purposely blocked out. We do not wish to disparage any recent books which emphasise one of these pictures to the practical exclusion of others. They serve their purpose. The pioneer is necessarily preoccupied with his own line of march. But there is a danger that, in the enthusiasm created by recent discoveries and the success attending the contemplation of picture C, the rest of the landscape will be forgotten. We can wish for no better training for a student than a perusal of Prof. Chwolson's treatise.

Of the general character of the book in its French form we may say that we do not like it quite so well as the German. The illustrations, which are taken from the German translation, do not show up as satisfactorily on the paper selected. But the production of a French translation will be welcomed by many to whom German is not intelligible; and it may be said without any hesitation that, in the form in which it now appears, we have a text-book of physics which is second to none in the French language. It should be in the library of every physical laboratory, and students who are taking up the subject of physics seriously will find it one of the best text-books of which to obtain private possession.

FLOWER POLLINATION.

Handbook of Flower Pollination. By Dr. P. Knuth. Based upon Hermann Müller's work, "The Fertilisation of Flowers by Insects." Translated by Prof. J. R. Ainsworth Davis. Vol. iii. (Band ii., Teil ii., of the German edition), Observations on Flower Pollination made in Europe and the Arctic Regions on Species belonging to the Natural Orders. Goodenovieæ to Cycadeæ. Pp. iv+644. (Oxford: Clarendon Press, 1909.) Price 28*s.* net.

VOL. III. of the English translation, which has now appeared, concludes that portion of Knuth's handbook for which that author was himself responsible. The later volumes, issued after Knuth's death by Dr. E. Loew, deal with observations on flower pollination made beyond the confines of Europe, while the earlier volumes contain the observations made in Europe and the Arctic regions, vol. iii. dealing with species belonging to the orders Goodenovieæ to Cycadaceæ.

The English translation, appearing, as it does, ten years after the publication of the original German edition, has been brought up to date in many respects. The arrangement of the Natural Orders has been altered in consonance with more recent classification, and some Orders have been merged as Sub-orders in the larger Families. In many instances new observations have been added, and additional literature is referred to, as, for instance, in the case of the primrose, the pollination of which has been much disputed, and also in the case of Pentstemon, of which genus Loew has latterly made a very considerable study.

This volume, like its predecessor, must be regarded as a most valuable book of reference, yet here and there are points of more general interest to which, perhaps, reference should be made. On p. 434, when dealing with the flower of the snowflake (Leucojum), Knuth gives an interesting summary of the method he has adopted to detect the presence of a nectary, when the position of that organ is not obvious at first sight. By suitable treatment of flowers with Fehling's solution or Hoppe-Seyler's sugar reagent he was able to detect the nectar-secreting part of most flowers. Sometimes even fairly conspicuous flowers, as, for instance, those of *Pyrola uniflora*, were found to be nectarless, and in this case, though the flower is otherwise obviously adapted to insect pollination, no insect visitors are recorded in the handbook. Indeed, this volume, like the preceding one, would yield much valuable information to anyone in search of opportunities of enriching botanical science by accurate observations in the field, for a number of plants, some of them quite common, still require their insect visitors to be recorded.

Some of the orders, like the Ericaceæ, are of interest, because in some genera, *e.g.* Calluna, Erica, and Cyclamen, the flowers, though adapted to insect pollination, and very eagerly visited by insects, are during their later stages anemophilous, the pollen becoming dry and powdery, and being readily carried by wind. On the other hand, some flowers normally adapted to wind pollination, like the sweet chestnut (Castanea), also attract insects, and are no doubt pollinated by them.

The translator has omitted to note the observations made recently on the dog's mercury (Mercurialis), which indicate that this plant is provided both with nectaries and sticky pollen, so that though apparently anemophilous, and probably at times wind pollinated, it is adapted to the visits of insects, and, as Knuth records, is often visited by them.

The anemophilous Gramineæ, too, offer many points of interest in connection with the frequent occurrence of cleistogamy and self-pollination of their flowers. Insect visits are occasionally observed in this group. Ludwig considered that the succulent shining lodicules of many grasses sometimes

attract flies, which are often imprisoned by the rapid closing of the glumes. These flies seem often affected by the entomophthora disease, and it is suggested that when so suffering they are often compelled by thirst to seek the juice of the lodicules. In other cases, no doubt, they visit the flowers for the purpose of collecting pollen.

A very valuable appendix, occupying about 100 pages, is added to the volume, and gives a systematic list of the various insects which have been observed visiting flowers and the flowers which they usually frequent. This carefully compiled list will be as informing to the entomologist as to the botanist. The index of plants described in the volume which figures in the German edition has not been added in the translation, but is probably held over for the final volume.

The style of the English rendering is fluent, and generally free from the flaws that mark some translations, though the volume opens with a serious blunder in describing the flowers of Lobelia as actinomorphous. Hälftig-symmetrisch is, of course, bilaterally symmetrical or zygomorphic, as is, indeed, indicated by the concluding portion of the sentence which describes the bifid upper and the trifid lower lip. It is unfortunate that the translator has retained the use of the word œcology as a synonym for biology, in dealing with observations on flower pollination. Though formerly used in that sense, œcology has of late years been so definitely and much more correctly applied to the study of plant-life in relation to environment that it seems out of place when used for floral biology.

Apart from such minor defects, the translation will be welcomed as rendering Knuth's monumental work accessible to a wider circle of readers and students of plant biology.

PRACTICAL WORK FOR ELECTRICAL LABORATORIES.

Leitfaden zum elektrotechnischen Praktikum. By Dr. G. Brion. Pp. xiv+404. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 11 marks.

THE laboratory has always been regarded as a necessary complement to the class-room so far as physics and chemistry are concerned, but for engineering subjects it is a comparatively modern institution. There are still engineers amongst us who have had to go through their university training without enjoying the use of a laboratory, but within the last generation all technical universities and colleges have recognised the immense importance of laboratory work, and have fitted up hydraulic, heat, mechanical, and electrical laboratories on a more or less extensive scale. Teachers, as well as engineers in practice, are agreed on the necessity of supplementing the theoretical work of the class-room by experiment, and there is keen competition between the different institutions as regards the best equipment, each trying to profit by the experience of the others, and to adapt the plant to the special industrial requirements of its district.

The best equipped laboratory would, however, be of little value without good organisation in its use and scientific instruction in the way of carrying out experiments. The book under review is an attempt, and, let us hasten to say, a very successful attempt, to supply such instruction. Of all Continental technical high schools, Dresden has at the present moment the best equipped electrical engineering laboratory, and since its head, Prof. Goerges, is not only an accomplished teacher, but also an engineer of high reputation, we may expect that a book, treating of laboratory work as carried on under him, will prove a most useful publication. The author is lecturer at Dresden, and in the preface says that the methods described have been worked out from time to time by various members of the staff. This does not mean that the methods described, or even a majority of them, are new, but simply that all the methods described have actually been used in that laboratory, and that in this way the educational value of each has been put to the test.

If an author describes the equipment of and work done in the laboratory in which he works himself, there is danger that he will produce a somewhat one-sided account, but from such a reproach Mr. Brion is entirely free. All the author has to say on testing applies to any well-equipped laboratory, and there is a remarkable absence of references to special apparatus. He evidently does not hold with the custom of giving the student cut-and-dried instructions, such as "take Messrs. So and So's testing set, connect in such a manner, then turn the handle and read off the result." Wherever possible he not only lets the student build up his apparatus, but he gives him also a short theory of the test. The object of the student's work in the laboratory is primarily to verify by experiment certain physical relations of which he has heard the theory in the class-room. Since, however, the simple and fundamental physical relations are in practical machinery often overshadowed by secondary disturbing causes, it is important that these should be pointed out to the student, and that he should thus be trained to scrutinise his results so as to separate that which is important from that which is merely accidental or disturbing. In this direction, Mr. Brion has given us good advice in sufficient detail. To give such advice it is, however, necessary to introduce a certain amount of theoretical matter on a mathematical basis.

A casual glance through the pages of this book gives one more the impression of a text-book than of a laboratory manual, but on closer inspection one finds that only as much theory is introduced as is necessary for intelligent working. Among the good features of the book are the diagrammatic representations of circuits, machines, and apparatus. With a correct appreciation of the probability that the students who work now in the laboratory will in a year or two be working in practice, Mr. Brion has adopted in his diagrams the symbolic representation recommended by the Verband Deutscher Elektrotechniker. He also uses thick lines to represent wires which carry main currents and thin lines for wires carrying shunt currents or for voltmeter wires. This is apparently a small matter, but anyone who has to trace out the circuits in some complicated electrical